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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Applicant: Chan	Art Unit: 2613
Serial No.: 09/932,127	Examiner: Lee
Filed: August 16, 2001	50R4781
For: ERROR CONCEALMENT OF VIDEO DATA USING TEXTURE DATA RECOVERY	April 14, 2004 750 B STREET, Suite 3100 San Diego, CA 92101

RULE 131 DECLARATION

Commissioner of Patents and Trademarks
Washington, DC 20231

Dear Sir:

I, Harold Fujii, declare as follows:

Joseph Chan is the original inventor of the invention claimed in the above-captioned application. Mr. Chan is no longer employed by the present assignee, Sony Electronics Inc., and his present whereabouts are unknown.

As evidenced by the enclosed Sony Invention Disclosure form signed and dated by Mr. Chan April 5, 2001, Mr. Chan conceived of the present invention at least prior to July 10, 2001. Specifically, using the limitations of Claim 1 as an example and referring to the enclosed Sony Invention Disclosure form and in particular Figure 1 thereof, Mr. Chan conceived of a method for concealing errors in texture partition of a video packet that includes determining a particular macroblock within the texture partition where error is detected (step 1 in Figure 1), concealing the error starting at the particular macroblock (step 4), and then evaluating image smoothness of concealed macroblocks (step 5). Figure 1 also shows repeating the concealing and evaluating acts with one more macroblock added prior to the previous particular macroblock (step 6, wherein K is incremented, and the decision

diamond immediately following, wherein if the loop is not ended the process loops back step 4). Figure 1 shows that the repeating is done until all macroblocks in the texture partition have been concealed. Note that because N macroblocks are stored at step 3, and K is initialized at step 2 as being the location of the error, incrementing K results in obtaining the macroblock added prior to the previous particular macroblock, see also the explanation of these steps in paragraphs 3 and 7 of the enclosed document. The enclosed document further describes selecting the set of macroblocks, including a combination of decoded and concealed macroblocks, that produces best image smoothness, see in particular the last sentence of paragraph 5.

The enclosed document also shows features of the dependent claims.

I declare that Mr. Chan was diligent in reducing the invention to practice at least from a time prior to July 10, 2001. Specifically, I declare that Mr. Chan submitted the enclosed invention disclosure prior to July 10, 2001 to Sony Intellectual Property Department, which then diligently processed the application for disclosure to outside counsel and subsequent filing within the usual course of Sony business in filing patent applications.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United State Code and that such willful, false statements may jeopardize the validity of the application or any patent issued thereon.

April 14, 2004

BY: Harold Fujii/date
Vice President, Intellectual Property, Sony Electronics, Inc.

1186-121.DEC

Respectfully submitted,

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Invention Disclosure Data Sheet

A. Existing problems

In an MPEG-4 decoder used for real-time streaming, when an error in a video packet, all decoded texture information of the packet is usually discarded. The region of the video frame corresponding to this corrupted packet is then generated by error concealment process. Motion compensated temporal replacement is usually an effective error concealment technique. However, there are times when the texture cannot be adequately concealed just by copying texture from previous frame at some motion compensated displacement.

B. Invention Description

In concealing corrupted video packets, the decoder attempts to utilize uncorrupted received texture information. Macroblock boundary matching is evaluated for varying amount of utilized texture information. The final amount of utilized decoded texture information (the recovered information) is selected to maximize overall boundary matching. The flow chart of this process is shown in Figure 1.

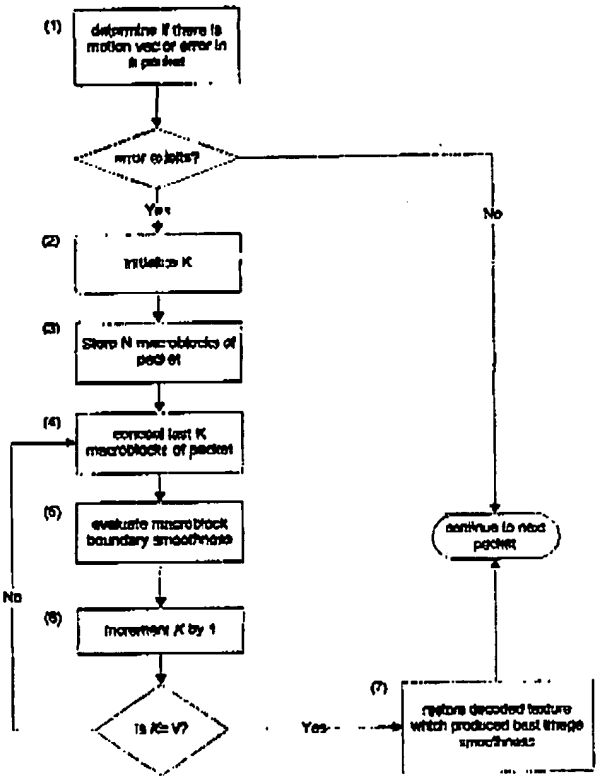

Figure 1: *Error concealment with texture data recovery flowchart*

The numbering of the following sections are descriptions of the steps in Figure 1 with same numbering.

(1) **Packet Error Detection**
Errors of a video packet can be detected if invalid variable length code (VLC), inconsistent resynchronization header information or out-of-range motion vectors are received. Note that since variable length codes are used, the location where the decoder detects an error (i.e. where invalid VLC occur) is usually some undetermined number of bits away from where the actual start of the error. Figure 2 shows an example of a corrupted video packet. The techniques for packet error detection are outside the scope of this invention.

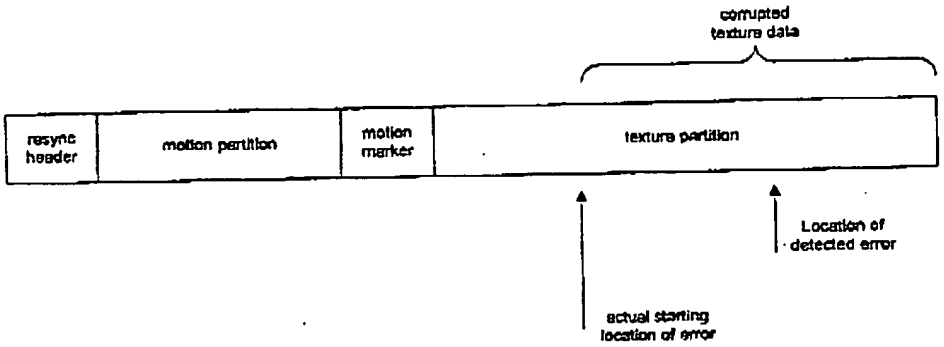

Figure 2: *Example of corrupted video packet*

(2) **Initialize *K*:**
K is initialized to the number of macroblocks in the packet that was decoded after the first detected error of the packet. This initial value of *K* will be the least number of macroblocks that will be concealed.

(3) **Store Decoded Texture**
In MPEG, a video frame is divided into macroblocks. Each video packet contains information for consecutive macroblocks from left to right and then top to bottom. The number of macroblocks (*N*) represented by each video packet can be determined by the change in macroblock number field of the video packet header.

In this step, the decoded texture (luminance and chrominance information) of the first *N-K* macroblocks is stored in temporary buffer. This will be used later in step (7)

(4) **Conceal Last *K* macroblocks:**
The last *K* macroblocks of current packet is concealed by a technique such as decoder motion estimated temporal replacement (described in IPD 50P4109.01), the first *N-K* macroblocks may or may not be considered as corrupted inside the concealment process.

(5) Evaluate Macroblock Boundary Matching:
Boundary matching of the corrupted video packet macroblocks is evaluated. In this step, the first *N-K* macroblocks use decoded texture while the last *K* macroblocks are concealed from step (4). One approach in evaluating boundary matching is by summing the pixel value mismatch between macroblock boundary pixels for all macroblocks of the corrupted video packet. The boundary pixel mismatch ($\mu 1$) of macroblock X in Figure 3 is computed as:

$$\mu 1 = \sum_{i=0}^{15} w_o \cdot (X_{0,i} - A_{15,i})^2 + w_b \cdot (X_{15,i} - B_{0,i})^2 + w_l \cdot (X_{i,0} - L_{i,15})^2 + w_r \cdot (X_{i,15} - R_{i,0})^2$$

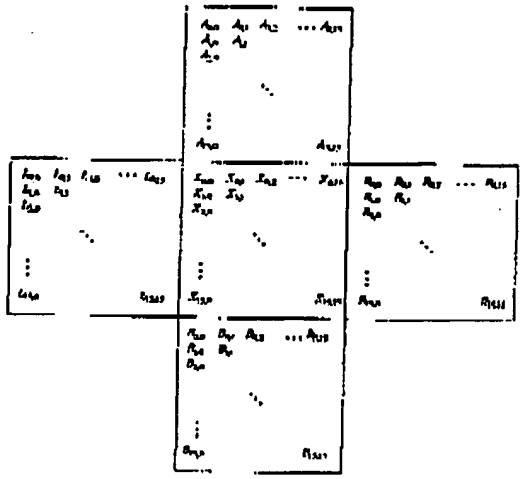

Figure 3: *Macroblock pixel values*

By storing the partial sum of mismatch values (mismatch values for each macroblock), the sum of mismatch values in each iteration of this step can be computed more efficiently by reusing the partial mismatch values from previous iteration for macroblocks that did not change.

The weights *wa, wb, wl,* and *wr* can be used to weigh the boundary mismatch between macroblocks belonging to different video packets more.

The value of *K* that produces the best overall boundary matching (smallest sum of boundary pixel mismatch for all macroblocks of the corrupted video packet) is stored as K_{best} for later use in step (7).

(6) Increment *K*
The variable *K* is incremented by 1 and steps (4) and (5) are repeated with one more macroblock concealed. This occurs until *K* is *N*, in which case the all macroblocks are concealed.

(7) Select combination of concealed and recovered macroblocks
The texture of the first $N\text{-}K_{best}$ macroblocks is restored from the temporary buffer created in step (2). The texture of these macroblocks is the recovered texture.

Signature of Submitter(s)				Read and understood by: Signatures of Witnesses (at least two witnesses preferred)		
Joseph Chang	Date	4/5/01		[signature]	Date	4/6/01
	Date				Date	
	Date				Date	
	Date				Date	